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(54) PLASTIC LENS FOR SPECTACLES

(57)Abstract:

PURPOSE: To establish an integrated production process by forming a layer for changing a refraction factor and/or a hard layer on a spectacle plastic lens through the plasma CVD method and, then, further applying an antireflection coat and/or a water yellowing prevention coat to the surface of the layer. (transparent resin base material).

CONSTITUTION: The monomars of each an organic titanium compound containing an alkoxy group, and an organic silicon compound containing an alkoxy group in a gaseous phase are contained in a decompression vessel, and introduced to a decompression vessel in a plasma atmosphere. Then, the thin film of a formation compound generated from the monomars via plasma reaction are deposited on a base material under the change of a refraction factor, thereby forming an intermediate matching layer between the base material and a hard coat. Thereafter, an organic silicon compound thin film as an intended hard coat containing the alkoxy group is formed on the surface of the matching layer. An antireflection film is further formed on the thin film. A liquid-waste

type thin film of a fluorine and/or silicon organic compound may be formed on the antireflection film, whenever necessary.

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CLAIMS

[Claim(s)]

[Claim 1] The plastic lens for glasses which consists of a hard layer formed by the plasma-CVD method on a glasses plastic lens base material and this base material.

[Claim 2] The plastic lens for glasses which consists of a layer to which the refractive index formed by the plasma-CVD method on a glasses plastic lens base material and

this base material is changed.

[Claim 3] The plastic lens for glasses which consists of a hard layer formed by the plasma-CVD method on the layer to which the layer to which a glasses plastic lens base material and the refractive index formed by the plasma-CVD method on this base material are changed, and this refractive index are changed.

[Claim 4] The plastic lens for glasses which was formed in order by the glasses plastic lens base material and the plasma-CVD method on this base material and which consists of the layer, hard layer, and antireflection film to which a refractive index is changed.

[Claim 5] The plastic lens for glasses which was formed in order by the glasses plastic lens base material and the plasma-CVD method on this base material and which consists of the layer to which a refractive index is changed, the hard layer on it, antireflection film, and an organic compound thin film.

[Claim 6] The plastic lens for glasses according to claim 1 said whose hard layers are Ti content and/or Si content organic compound thin film.

[Claim 7] The plastic lens for glasses according to claim 3 with which the refractive index becomes low as the layer to which said refractive index is changed has the almost same refractive index as the refractive index of a plastic lens base material in a plastic lens side and becomes close to a hard layer side.

[Claim 8] The plastic lens for glasses according to claim 7 whose layers to which said refractive index is changed are Ti content and/or Si content organic compound thin film.

[Claim 9] The plastic lens for glasses according to claim 8 said Ti content and/or whose Si content organic compound thin film are an alkoxy group content organic titanium compound thin film and/or an alkoxy group content organosilicon compound thin film.

[Claim 10] The plastic lens for glasses according to claim 7 or 8 the range of whose refractive index of the layer to which said refractive index is changed is 1.48-1.70.

[Claim 11] The plastic lens for glasses according to claim 3, 4, or 5 whose layers and hard layers to which said refractive index is changed are Ti content and/or Si content organic ghost thin film.

[Claim 12] The plastic lens for glasses according to claim 3, 4, or 5 whose layers and/or hard layers to which said refractive index is changed are an alkoxy group content organic titanium compound thin film and/or an alkoxy group content organosilicon compound thin film.

[Claim 13] Said alkoxy group content organic titanium compound thin film and an

alkoxy group content organosilicon compound thin film are the following general formula [I] and [II] respectively.
Ti4 (OR) [I]
(R is an alkyl group among a formula.)
R1xSi 4-x (OR2) [II]
(-- R1 and R2 are alkyl groups among a formula, and x is the integer of 0-3.) -- plastic lens for glasses according to claim 9 or 12 which consists of matter expressed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the rebound ace court film formed on the glasses plastic lens base material by the plasma-CVD method.
[0002]
[Description of the Prior Art] Conventionally, as an approach of forming a rebound ace court on a glasses plastic lens base material, after forming an organic silicone coat by the dipping method (immersion processing) first, the antireflection film is formed with the vacuum deposition method.
[0003] The five to JP140356 patent shows how to form the SiOx film on the transparent plastics windowpane for automobiles by the plasma-CVD method in order to raise adhesion and surface hardness. We applied this approach in order to form a rebound ace court on a plastics spectacle lens. However, this approach was not suitable for our object. That is because this film exfoliated easily in the hot water test (80 degrees C, 10 minutes). Furthermore, in this patent, only the approach of forming a hard layer is indicated, and in order to control the interference fringe of a plastics spectacle lens which has various refractive indexes, the publication in which a monomer is fitted to a hard layer is not seen at all.
[0004] The EP203730 patent first shows how to form the organic hydrophobic film for the organic silicone compound film subsequently to an antireflection film and the last by the conventional dipping on the base material for optics. The first approach (hard coating) needs much time amount for the conventional dipping method, and cannot perform the process from hard coating to hydrophobic layer processing continuously further. That is because the base material which carried out the rebound ace court must be exposed to air in case the first process is changed into the second process,

i.e., vacuum deposition. The EP203730 patent has not suggested at all a technique like invention of us who are the new approaches of forming a hard layer on a plastics spectacle lens by the plasma-CVD method.

[0005] The 62 -247302 patent shows how to form the organic silazane compound film on the non-organic antireflection film with which a front face serves as hydrophobicity. This patent does not show the possibility of forming the consistent process line at all. The consistent process line is possible for our invention.

[0006]

[Problem(s) to be Solved by the Invention] However, the actual condition is that the organic silicone coat (rebound ace court) obtained by such conventional method must develop the refractive index corresponding to this with a raise in the refractive index of the plastic lens itself, and the burden of development costs is becoming heavy. Moreover, since a facility of dipping equipment etc. turns into a facility which corresponds for every refractive index of a plastic lens, it is the inclination to have to install two or more dipping equipments in a plant, and for the cost depreciation expenses of a facility to increase every year. Furthermore, by recently, since it is becoming the inclination which receives the order of a custom-made item, an order is received in one pair (two sheets) like a spectacle lens, and the process which flows the consistent production line of a plant as it is is examined. However, having the dipping equipment line [like] from the former installed two or more sets has the fault to which productive efficiency worsens dramatically, when an integrated production manufacturing system is taken into consideration. Moreover, when performing the rebound ace court by the conventional dipping, as surface treatment before carrying out a coat, the activation of a front face which is dipped in an alkali solution etc. is indispensable, and problems used for these from an environmental problem etc., such as waste fluid processing, are beginning to arise recently. A condensation hardening process is indispensable, and in order that the time amount spent on this process may require for the production process of the conventional rebound ace court for several hours, when measuring shortening of a delivery date, by it, it has been a problem on a very important improvement further again.

[0007] the antireflection film formed a rebound ace court and on it in the same production process not using the rebound ace court by dipping which is the wet method which this invention solves the above-mentioned trouble and is held from the former -- further -- again -- a it top -- water YAKE prevention -- a coat -- it is in offering the new manufacture approach of processing even a thin film with water repellence consistently.

[0008]
[Means for Solving the Problem] In this invention, the above-mentioned technical problem was solved by the thin film formation approach using PECVD (Plasma-enhanced chemical vapour deposition).
[0009] In this invention, each monomer of an alkoxy group content organic titanium compound and an alkoxy group content organosilicon compound is made into a gaseous state into a reduced pressure container. By introducing this into the reduced pressure container of a plasma ambient atmosphere, and carrying out the thin film deposition of the formation compound generated at a plasma reaction from those monomers on a base material, changing a refractive index An in-between matching layer is formed between a base material and a rebound ace court, and the alkoxy group content organosilicon compound thin film which is an original rebound ace court is formed on it. Furthermore, the antireflection film is formed on it. Moreover, the water-repellent thin film which consists of a fluorine system and/or a silicon system organic compound further can also be formed on an antireflection film if needed.
[0010] Hereafter, this invention is explained to a detail. The transparence resin base material used in this invention A polycarbonate, polymethylmethacrylate, and its copolymer, Diethylene-glycol bisallyl carbonate (CR-39), polyester, Especially Polyethylene terephthalate and unsaturated polyester, an acrylonitrile styrene copolymer, Although chosen from the addition polymer of the monochrome or di(meth)acrylate containing a vinyl chloride, polyurethane, an epoxy resin, a halogen (however, a fluorine is removed), and a hydroxy group, and an isocyanate compound, or its copolymer as arbitration The addition polymer of the monochrome or di(meth)acrylate which contains CR-39, polyurethane, a halogen (however, a fluorine is removed), and a hydroxy group preferably, and an isocyanate compound, or its copolymer is used.
[0011] When forming the layer and/or hard layer which change a refractive index to a transparence resin base material, introduce Ti system and/or Si system alkoxy group content organic compound monomer, and oxygen gas to a vacuum chamber, it is made to react in a plasma ambient atmosphere as those formation ingredients, and a transparence resin base material is made to deposit a thin film.
[0012] The plasma-CVD method used in this invention is made to discharge by giving heat energy and electric energy to material gas, a reaction is promoted in the non-heat parallel condition in the plasma ambient atmosphere, it is the approach of making a thin film depositing on a substrate, and a parallel plate electrode mold, a capacity-coupling mold, or an inductive-coupling mold is used for what is usually used.

especially -- this invention -- setting -- the perpendicular direction of a vacuum chamber -- a cathode and an anode -- opposite ---like -- arranging -- the vertical direction besides a vacuum chamber -- electromagnetism -- the plasma acceleration CVD (PECVD) which arranges a coil and prepares a KARO cel type substrate electrode holder vertically between a cathode and an anode -- forming by law is suitable. That is, according to this approach, since it is made to equalize a plasma consistency without the ion breakage to a transparence resin substrate broadly, it is the very optimal technique for the plastic lens for glasses.

[0013] In Ti system used for the layer and/or hard layer to which a refractive index is changed in this invention, and Si system alkoxy group content organic compound The example in Ti system A titanium iso PUROPI rate, titanium butylate, Tetraisopropoxy titanium, tetra-n-butyl titanate, tetrapod (2-ethylhexyl) titanate, A diethoxy titanium screw (acetylacetonate), titanium diacetyl acetonate, titanium diacetyl acetate, titanium octyl glycolate, titanium lactate, titanium lactate ethyl ester, titanium triethanol friend NETO, etc. are raised. Moreover, in the example of Si system, a tetra-ethoxy silane, tetramethyl disiloxane, dimethoxy dimethylsilane, methyl trimetoxysilane, a tetramethoxy silane, ethyltrimethoxysilane, diethoxy dimethylsilane, methyl triethoxysilane, an octamethyl cyclo tetra-silane, etc. are used suitably. These Ti systems and Si system alkoxy group content organic compound may use one of them independently, and may use two or more kinds together.

[0014] Moreover, what is expressed with following unit type Cp F2p+1CH2 CH2 Si (NH)1.5 (the inside of a top type and p are forward integers) as an organic silazane compound used for a water YAKE prevention coat in this invention is used suitably.

[0015] Next, the concrete manufacture approach by this invention is shown below. Ti system and the monomer container containing Si system alkoxy group content organic compound are connected to the vacuum chamber, and by heating this container from the outside, oxygen gas is also introduced at the same time it makes it evaporate and introduces to a vacuum chamber. although the flow rate of each gas at that time should just choose the thing appropriate for each object suitably, preferably, in the case of the gas of Si system alkoxy group content organic compound, in the case of the gas of 80 - 200SCCM and Ti system alkoxy group content organic compound, it is 30 - 200SCCM, and oxygen gas is independent in 50 - 200SCCM respectively -- or it is made to use together and passes to a vacuum chamber. Moreover, the pressure in the vacuum chamber in this case is stabilized in 0.5-2.5Pa, and 2-3.5kW of RFs is impressed to a cathode side. It and coincidence are made to stabilize depression arc discharge as a field starts in a current the electromagnet coil currently installed in the

vacuum chamber exterior into a sink and a plasma ambient atmosphere. Moreover, between the electrodes which counter, electric field happen depending on such how to apply a field, and the ion in the plasma is accelerated at a substrate electrode-holder side. Moreover, a plasma consistency is equalized by this electric field and ion breakage, a temperature rise, etc. to a substrate can be controlled. Therefore, when treating the ingredient with which a side chain radical tends to be fractured by ion breakage when making a thin film form in a substrate ingredient like especially a plastic lens, a heat-resistant low ingredient, etc., very effective thin film formation is attained. By such technique, the layer to which the hard layer and/or refractive index which consist of a direct Ti system and/or an Si system content organic compound thin film are changed can be formed on a plastic lens above. Furthermore, an antireflection film can be made to form on this with physical vacuum deposition. An organic silazane compound can be used and a water YAKE prevention coat can be made to form on the antireflection film further again with immersion processing (dipping coat), a vacuum deposition method, or a CVD method. When forming the layer to which especially a refractive index is changed, it becomes possible by controlling the flow rate and/or RF output (RF power) at the time of monomer gas installation to accuracy to change a continuous refractive index in the interior of the same thin film.

[0016]

[Example] Hereafter, although an example and the example of a comparison explain this invention concretely, this invention is not restricted to the following example.

[0017] The RF output of 2kW is impressed to a cathode for 3 minutes at the same time it introduces the gas of methyl triethoxysilane until the pressure of a flow rate 100SCCM sink and a vacuum chamber is set to 0.7Pa and passes the current of 5A in an external electromagnet coil, after installing in the vacuum chamber of the PECVD equipment made from Balzers after washing through example 1CR-39 lens at an ultrasonic washing machine and exhausting up to 2.7x10 to 4 Pa. Then, it is the RF output of a cathode gradually 40 W/min It raises at a rate gradually and controls to amount to 2.5kW in 12 minutes. The flow rate of the monomer gas for these 12 minutes is set to 180SCCM(s), is fixed, and formed the layer to which a refractive index is changed in this process. When the refractive index of the formed thin film was measured with the spectrophotometer at this time, it was nd 1.48 in the nd 1.50 and medium (air) side at the lens interface side.

[0018] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through example 2CR-39 lens at an ultrasonic washing machine. After

exhausting up to 2.7x10 to 4 Pa, the gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.1Pa in flow rate 180SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 20 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. While the pressure of a vacuum chamber was set to 2.5Pa, the RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 20 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 20 minutes further again. It was nd 1.50 when the refractive index of the formed thin film was then measured with the spectrophotometer.

[0019] The RF output of 2kW is impressed to a cathode for 3 minutes at the same time it introduces the gas of methyl triethoxysilane until the pressure of a flow rate 100SCCM sink and a vacuum chamber is set to 0.7Pa and passes the current of 5A in an external electromagnet coil, after installing in the vacuum chamber of the PECVD equipment made from Balzers after washing through R-example 3C39 lens at an ultrasonic washing machine and exhausting up to 2.7x10 to 4 Pa. Then, it is the RF output of a cathode gradually 40 W/min It raises at a rate gradually and controls to amount to 2.5kW in 12 minutes. The flow rate of the monomer gas for these 12 minutes is set to 180SCCM(s), is fixed, and formed the layer to which a refractive index is changed in this process. Then, after setting an oxygen gas flow rate as a vacuum chamber, setting 50SCCM sink and a vacuum chamber pressure to 2.1Pa and forming a hard layer for 20 minutes, an oxygen gas flow rate is increased to 100SCCM(s). The RF output of a cathode is changed into 3kW at the same time it sets a sink vacuum chamber pressure to 2.5Pa to a vacuum chamber. A hard layer is formed for 20 more minutes, and finally an oxygen gas flow rate is continuously increased to 200SCCM(s). A sink, The vacuum chamber pressure adjusted the variable orifice for the conductance of an exhaust air system by open Lycium chinense so that it might hold to 2.5Pa as it is, and the RF output of a cathode is in the condition which held 3kW as they were, and formed the hard layer further again.

[0020] aluminum 2O3, ZrO2, and ZrO2 and SiO2 after it puts what was formed in example 4 example 3 into still more nearly another vacuum evaporator and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0021] the heat hardening during 65-degree-C 30 minutes after what was formed in

example 5 example 4 is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0022] It lets an example 6 acrylonitrile-styrene copolymer lens pass to an ultrasonic washing machine. After washing, After installing in the vacuum chamber of the PECVD equipment made from Balzers and exhausting up to 2.7x10 to 4 Pa, The gas of flow rate 80SCCM and dimethoxy dimethylsilane for the gas of methyl triethoxysilane A flow rate 140SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external electromagnet coil While impressing the high frequency output of 2kW to a cathode for 1.5 minutes, the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane per for 1 minute 80SCCM(s), The layer to which a refractive index is changed in 1.5 minutes was made to form, making it increase and decrease gradually at a rate of 93SCCM(s). When the refractive index of the formed thin film was then measured with the spectrophotometer, it was nd 1.48 in the nd 1.56 and medium (air) side at the lens interface side.

[0023] It lets an example 7 acrylonitrile-styrene copolymer lens pass to an ultrasonic washing machine. After washing, After installing in the vacuum chamber of the PECVD equipment made from Balzers and exhausting up to 2.7x10 to 4 Pa, The gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again. It was nd 1.56 when the refractive index of the formed thin film was then measured with the spectrophotometer.

[0024] It lets an example 8 acrylonitrile-styrene copolymer lens pass to an ultrasonic washing machine. After washing, After installing in the vacuum chamber of the PECVD equipment made from Balzers and exhausting up to 2.7x10 to 4 Pa, The gas of flow rate 80SCCM and dimethoxy dimethylsilane for the gas of methyl triethoxysilane A flow rate 140SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external

electromagnet coil While impressing the high frequency output of 2kW to a cathode for 1.5 minutes, the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane per for 1 minute 80SCCM(s), The layer to which a refractive index is changed in 1.5 minutes was made to form, making it increase and decrease gradually at a rate of 93SCCM(s). Furthermore continue and the gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 25kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again.

[0025] aluminum 2O3, ZrO2, and ZrO2 and SiO2 after it puts what was formed in example 9 example 8 into still more nearly another vacuum evaporator and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0026] the heat hardening during 65-degree-C 30 minutes after what was formed in example 10 example 9 is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0027] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 11 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of flow rate 35SCCM and dimethoxy dimethylsilane for the gas of methyl triethoxysilane A flow rate 148SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external electromagnet coil Increasing and decreasing gradually the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane at a rate of 110SCCM(s) and 98.7SCCM per for 1 minute, while impressing the high frequency output of 2kW to a cathode for 1.5 minutes The layer to which a refractive index is changed in 1.5 minutes was made to form. When the refractive index of the formed thin film was then measured with the spectrophotometer, it was nd 1.58 in the nd 1.62 and medium (air) side at the lens

interface side.

[0028] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 12 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again. It was nd 1.60 when the refractive index of the formed thin film was then measured with the spectrophotometer.

[0029] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 13 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of flow rate 35SCCM and dimethoxy dimethylsilane for the gas of methyl triethoxysilane A flow rate 148SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external electromagnet coil Increasing and decreasing gradually the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane at a rate of 110SCCM(s) and 98.7SCCM per for 1 minute, while impressing the high frequency output of 2kW to a cathode for 1.5 minutes The layer to which a refractive index is changed in 1.5 minutes was made to form. Furthermore continue and the gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again.

[0030] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it puts what was formed in example 14 example 13 into still more nearly another vacuum evaporator and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0031] the heat hardening during 65-degree-C 30 minutes after what was formed in example 15 example 14 is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0032] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 16 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of flow rate 35SCCM and tetraisopropoxy titanium for the gas of methyl triethoxysilane A flow rate 148SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external electromagnet coil Increasing and decreasing gradually the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane at a rate of 110SCCM(s) and 98.7SCCM per for 1 minute, while impressing the high frequency output of 2kW to a cathode for 1.5 minutes The layer to which a refractive index is changed in 1.5 minutes was made to form. When the refractive index of the formed thin film was then measured with the spectrophotometer, it was nd 1.63 in the nd 1.67 and medium (air) side at the lens interface side.

[0033] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 17 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time, it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again. It was nd 1.65 when the refractive index of the formed thin film was then measured with the spectrophotometer.

[0034] It installs in the vacuum chamber of the PECVD equipment made from Balzers after washing through an example 18 polyurethane system lens at an ultrasonic washing machine. After exhausting up to 2.7x10 to 4 Pa, the gas of flow rate 35SCCM and tetraisopropoxy titanium for the gas of methyl triethoxysilane A flow rate 148SCCM sink, At the same time it introduces until the pressure of a vacuum chamber is set to 2.0Pa, and it passes the current of 5A in an external electromagnet coil Increasing and decreasing gradually the gas of methyl triethoxysilane, and each flow rate of dimethoxy dimethylsilane at a rate of 110SCCM(s) and 98.7SCCM per for 1 minute, while impressing the high frequency output of 2kW to a cathode for 1.5 minutes The layer to which a refractive index is changed in 1.5 minutes was made to form. The gas of methyl triethoxysilane in the place by which the pressure of a flow rate 50SCCM sink and a vacuum chamber was set to 2.0Pa in flow rate 200SCCM and oxygen gas, and the flow rate was stabilized Impress the RF output of 2.5kW to a cathode for 17 minutes, form a hard layer, and the flow rate of oxygen gas is further increased to 100SCCM(s) at the same time it passes the current of 5A in an external electromagnet coil. Open Lycium chinense adjusts a variable orifice for the conductance of an exhaust air system so that the pressure of a vacuum chamber may be set to 2.0Pa. The RF output of a cathode was raised to 3kW, the hard layer was succeedingly formed for 17 minutes, finally, the flow rate of oxygen gas was increased to 200SCCM(s), and the hard layer was formed for 17 minutes further again.
[0035] aluminum 2O3, ZrO2, ZrO2, aluminum 2O3, and SiO2 after it puts what was formed in example 19 example 18 into still more nearly another vacuum evaporator and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.
[0036] the heat hardening during 65-degree-C 30 minutes after what was formed in example 20 example 19 is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.
[0037] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it installs what was formed in example 21 example 3 in vacuum chamber with the still more nearly another PECVD equipment made from Balzers and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo. the ceramics to which impregnation of the hexamethyldisilazane was furthermore carried out is evaporated with resistance heating type vacuum deposition

in the pressure range of 1.3 to 3.3x10 to 2 Pa -- making -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.
[0038] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it installs what was formed in example 22 example 8 in vacuum chamber with the still more nearly another PECVD equipment made from Balzers and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo. the ceramics to which impregnation of the hexamethyldisilazane was furthermore carried out is evaporated with resistance heating type vacuum deposition in the pressure range of 1.3 to 3.3x10 to 2 Pa -- making -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.
[0039] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it installs what was formed in example 23 example 13 in vacuum chamber with the still more nearly another PECVD equipment made from Balzers and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo. the ceramics to which impregnation of the hexamethyldisilazane was furthermore carried out is evaporated with resistance heating type vacuum deposition in the pressure range of 1.3 to 3.3x10 to 2 Pa -- making -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.
[0040] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it installs what was formed in example 24 example 18 in vacuum chamber with the still more nearly another PECVD equipment made from Balzers and the pressure of a vacuum chamber exhausts it to 1.3x10-3Pa The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo. the ceramics to which impregnation of the hexamethyldisilazane was furthermore carried out is evaporated with resistance heating type vacuum deposition in the pressure range of 1.3 to 3.3x10 to 2 Pa -- making -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.
[0041] It lets example of comparison 1CR-39 lens pass to an ultrasonic washing machine. After washing to the cohydrolysate of the gamma-GURIKISHIDO propyltrimethoxysilane 35.3 section and the gamma-GURIKISHIDO propylmethyl diethoxysilane 106.8 section The methanol 185 section, Addition mixing of the acetylacetone 11.1 section and the silicone system surfactant 2.5 section is carried out. It is immersed in the rebound ace court constituent solution which furthermore added the aluminium acetylacetonato 6.0 section. After applying, preheating hardening

for 80-degree-C 10 minutes was performed, 100 more degree-C thing which carried out this heat hardening of 4 hours was created, and the plastic lens with a rebound ace court (nd 1.48) was obtained.

[0042] It lets example of comparison 2CR-39 lens pass to an ultrasonic washing machine. After washing to the cohydrolysate of the gamma-GURIKISHIDO propyltrimethoxysilane 35.3 section and the gamma-GURIKISHIDO propylmethyl diethoxysilane 106.8 section The methanol 185 section, Addition mixing of the acetylacetone 11.1 section and the silicone system surfactant 2.5 section is carried out. It is immersed in the rebound ace court constituent solution which furthermore added the aluminium acetylacetonato 6.0 section. After applying, what performed preheating hardening for 80-degree-C 10 minutes, and created 100 more degree-C thing which carried out this heat hardening of 4 hours After letting it pass to an ultrasonic washing machine, putting into a vacuum evaporator after washing again and the pressure of a vacuum chamber exhausting to 1.3x10-3Pa, aluminum 2O3, ZrO2, ZrO2, and SiO2 The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0043] the heat hardening during 65-degree-C 30 minutes after what was formed in the example 2 of example of comparison 3 comparison is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0044] It lets an example of comparison 4 acrylonitrile-styrene copolymer lens pass to an ultrasonic washing machine. After washing, To the cohydrolysate of the gamma-GURIKISHIDO propyltrimethoxysilane 35.3 section and the gamma-GURIKISHIDO propylmethyl diethoxysilane 106.8 section, the methanol 185 section, Addition mixing of the acetylacetone 11.1 section and the silicone system surfactant 2.5 section is carried out. It is immersed in the rebound ace court constituent solution which furthermore added the aluminium acetylacetonato 6.0 section. After applying, preheating hardening for 80-degree-C 10 minutes was performed, 100 more degree-C thing which carried out this heat hardening of 4 hours was created, and the plastic lens with a rebound ace court (nd 1.48) was obtained.

[0045] It lets an example of comparison 5 acrylonitrile-styrene copolymer lens pass to an ultrasonic washing machine. After washing, To the cohydrolysate of the gamma-GURIKISHIDO propyltrimethoxysilane 35.3 section and the gamma-GURIKISHIDO propylmethyl diethoxysilane 106.8 section, the methanol 185

section, Addition mixing of the acetylacetone 11.1 section and the silicone system surfactant 2.5 section is carried out. It is immersed in the rebound ace court constituent solution which furthermore added the aluminium acetylacetonato 6.0 section. After applying, what performed preheating hardening for 80-degree-C 10 minutes, and created 100 more degree-C thing which carried out this heat hardening of 4 hours After letting it pass to an ultrasonic washing machine, putting into a vacuum evaporator after washing again and the pressure of a vacuum chamber exhausting to 1.3x10-3Pa, aluminum 2O3, ZrO2, ZrO2, and SiO2 The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0046] the heat hardening during 65-degree-C 30 minutes after what was formed in the example 5 of example of comparison 6 comparison is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0047] It lets an example of comparison 7 polyurethane system lens pass to an ultrasonic washing machine. After washing to the cohydrolysate of the gamma-GURIKISHIDO propyltrimethoxysilane 35.3 section and the gamma-GURIKISHIDO propylmethyl diethoxysilane 106.8 section The methanol 185 section, Addition mixing of the acetylacetone 11.1 section and the silicone system surfactant 2.5 section is carried out. It is immersed in the rebound ace court constituent solution which furthermore added the aluminium acetylacetonato 6.0 section. After applying, preheating hardening for 80-degree-C 10 minutes was performed, 100 more degree-C thing which carried out this heat hardening of 4 hours was created, and the plastic lens with a rebound ace court (nd 1.48) was obtained.

[0048] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it puts into an ultrasonic washing machine after washing at a vacuum evaporator through the rebound ace court lens created in the example 7 of the example of comparison 8 aforementioned comparison and the pressure of a vacuum chamber exhausts to 1.3x10-3Pa again The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0049] the inside of the dipping solution tub into which hexamethyldisilazane went further what was formed in the example 8 of example of comparison 9 comparison -- being immersed -- after and heat hardening -- carrying out -- water YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0050] After having added the 0.05 convention hydrochloric-acid water-solution 36 section, creating hydrolyzate and adding the ethanol 56.6 section and the ethylene glycol 53.4 section to this, agitating the 10gamma-GURIKISHIDO propylmethyl diethoxysilane 248 of examples of a comparison section, the aluminum acetonate 4.7 section was added and the reserve constituent A was obtained.

[0051] After having added the centinormal hydrochloric-acid water-solution 48.6 section, creating hydrolyzate and adding the ethanol 77.1 section and the ethylene glycol 37.7 section to this, agitating the gamma-GURIKISHIDO propyltrimethoxysilane 212.4 section, the aluminum acetonate 7.65 section was added and the reserve constituent B was obtained.

[0052] It adds in the tungstic-acid water solution which carried out the ion exchange of the sodium tungstate water solution, and manufactured it, carrying out stannic-acid sodium water-solution churning, and they are WO3 / SnO2. The hydrosol of the complex of the weight ratio 1 was created.

[0053] Next, it is the hydrosol of the commercial tin oxide SnO2 The 100 sections are prepared by conversion and it is the above-mentioned complex sol WO3 SnO2 Churning addition of the 25 to 60 section was carried out at the room temperature by weight conversion, and the denaturation sol of specific gravity 1.03 was created. Then, it considered as the high concentration denaturation sol of specific gravity 1.172 by purification processing.

[0054] Addition mixing of the silicone surfactant 0.4 section was respectively carried out for the reserve constituents A and B at the 40 and 60 sections and the high concentration denaturation sol 50 section, and the rebound ace court constituent of a refractive index (nd 1.63) was obtained.

[0055] After being immersed in said rebound ace court constituent solution and applying to an ultrasonic washing machine after washing through a polyurethane system lens, 100-degree-C heat hardening of 2 hours was performed.

[0056] aluminum 2O3, ZrO2, ZrO2, and SiO2 after it puts into an ultrasonic washing machine after washing at a vacuum evaporator through the rebound ace court lens created in the example 10 of the example of comparison 11 aforementioned comparison and the pressure of a vacuum chamber exhausts to 1.3x10-3Pa again The multilayer antireflection film was controlled by the pressure range of 1.3x10-3 to 1.3x10 to 2 Pa in order, and it created by electron gun vacuum evaporationo.

[0057] the heat hardening during 65-degree-C 30 minutes after what was formed in the example 11 of example of comparison 12 comparison is immersed in the dipping solution tub into which hexamethyldisilazane went further -- carrying out -- water

YAKE prevention -- a coat -- the water-repellent thin film was formed on the antireflection film.

[0058] The result of having evaluated the obtained plastic lens for glasses is shown in a table 1. Moreover, the content of evaluation criteria is shown below.

Evaluation criteria 1) Adhesion Cross hatching trial Nichiban Scotch tape activity 2) Abrasion-proof nature Steel wool #0000 600g of loads 30 strokes / 15 seconds A sand rubber 500g of JIS502 loads 15 strokes / 10 seconds Warm water-proof [3] thermostat City-water activity Immersion during 80-degree-C 10 minutes 4) Thermal resistance Ayr . oven Neglect during 100-degree-C 5 minutes 5 alkali resistance It is 6 hours to a sodium-hydroxide (PH11) water solution. Immersion 6 acid resistance Nitric-acid water-solution (PH1) 6-hour immersion [0059]

[A table 1]

	密着性	耐擦傷性 SW	耐擦傷性 SE	耐温水性	耐アルカリ性	耐酸性	耐熱性
実施例 1	良好	A	A	良好	良好	良好	良好
実施例 2	良好	A	A	良好	良好	良好	良好
実施例 3	良好	A	A	良好	良好	良好	良好
実施例 4	良好	A	A	良好	良好	良好	良好
実施例 5	良好	A	A	良好	良好	良好	良好
実施例 6	良好	A	A	良好	良好	良好	良好
実施例 7	良好	A	A	良好	良好	良好	良好
実施例 8	良好	A	A	良好	良好	良好	良好
実施例 9	良好	A	A	良好	良好	良好	良好
実施例10	良好	A	A	良好	良好	良好	良好
実施例11	良好	A	A	良好	良好	良好	良好
実施例12	良好	A	A	良好	良好	良好	良好
実施例13	良好	A	A	良好	良好	良好	良好
実施例14	良好	A	A	良好	良好	良好	良好
実施例15	良好	A	A	良好	良好	良好	良好
実施例16	良好	A	A	良好	良好	良好	良好
実施例17	良好	A	A	良好	良好	良好	良好
実施例18	良好	A	A	良好	良好	良好	良好
実施例19	良好	A	A	良好	良好	良好	良好
実施例20	良好	A	A	良好	良好	良好	良好
実施例21	良好	A	A	良好	良好	良好	良好
実施例22	良好	A	A	良好	良好	良好	良好
実施例23	良好	A	A	良好	良好	良好	良好
実施例24	良好	A	A	良好	良好	良好	良好
比較例 1	良好	A	A	良好	良好	良好	良好
比較例 2	良好	A	A	良好	良好	良好	良好
比較例 3	良好	A	A	良好	良好	良好	良好
比較例 4	不良	B	A	良好	不良	良好	良好
比較例 5	不良	B	A	良好	不良	良好	良好
比較例 6	不良	B	A	良好	不良	良好	良好
比較例 7	不良	B	A	良好	良好	良好	不良
比較例 8	不良	B	A	良好	良好	良好	不良
比較例 9	不良	B	A	良好	良好	良好	不良
比較例10	良好	B	A	良好	不良	良好	良好
比較例11	良好	B	A	良好	不良	良好	良好
比較例12	良好	B	A	良好	不良	良好	良好

耐擦傷性の評価

A：傷が付かない。
B：多く傷が発生する。

[0060]

[Effect of the Invention] As explained above, according to this invention, Ti system and/or Si system alkoxy group content organic compound are used. By forming the layer and/or hard layer which change a refractive index on a glasses plastic lens by the plasma-CVD method, and performing an antireflection film and/or a water YAKE prevention coat on it further Since the consistent production process is established, indispensable surface activity-ized processing etc. becomes unnecessary in the further conventional wet rebound ace court and these waste fluid processings are lost, an environmental pollution problem is solvable. Moreover, even if compared with the rebound ace court by dipping from the former, a condensation hardening process is

lost, and it is effective in the ability to measure shortening of a delivery date.

[Translation done.]